Original Research

CORRELATION OF LIPID METABOLIC ABNORMALITIES WITH ACUTE CEREBRAL ISCHEMIC EVENTS

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ABSTRACT

Background: Stroke is one of the leading causes of mortality and long-term disability worldwide. Altered lipid metabolism plays an important role in the development of atherosclerosis and ischemic cerebrovascular disease. Dyslipidaemia is considered a major modifiable risk factor for acute cerebral ischemia. This study was conducted to evaluate the association between lipid profile abnormalities and acute cerebral ischemia.

Methodology: This hospital-based observational study was conducted in the Department of Emergency Medicine at Sree Mookambika Institute of Medical Sciences, Kulasekharam, from June 2025 to March 2026. Fifty patients aged between 40 and 80 years with CT/MRI confirmed ischemic or hemorrhagic stroke were included. Patients with liver disease, hypothyroidism, familial hypercholesterolemia, coagulation disorders, trauma, and those on lipid-lowering drugs were excluded. Fasting lipid profile and carotid intima-media thickness (CIMT) were assessed. Statistical analysis was performed using SPSS version 25.0, and $p<0.05$ was considered statistically significant.

Result: Among the study population, 66% had elevated total cholesterol, 72% had high LDL, 72% had elevated triglycerides, and 66% had low HDL levels. Significant association was observed between diabetes mellitus and elevated total cholesterol, triglycerides, and LDL levels ($p=0.001$). Increased CIMT was observed in a majority of patients.

Conclusion: Altered lipid metabolism is strongly associated with acute cerebral ischemia. Early identification and management of dyslipidaemia may reduce stroke-related morbidity and mortality.

Keywords: Acute Cerebral Ischemia, Dyslipidaemia, Lipid Profile, Stroke, Carotid Intima-Media Thickness, Atherosclerosis.

INTRODUCTION

Stroke or cerebrovascular accident (CVA) is one of the leading causes of mortality and long-term disability worldwide. It is an acute neurological injury resulting from interruption of cerebral blood flow due to vascular pathology, presenting either as cerebral infarction or intracerebral haemorrhage. Ischemic stroke accounts for approximately 80–85% of all stroke cases and remains a major public health burden, particularly in developing countries. Early recognition of modifiable risk factors is essential for reducing the incidence and recurrence of stroke. [1,2]

With increasing life expectancy and ageing populations, the prevalence of stroke is expected to Rise significantly in the coming decades. Stroke not only contributes to increased mortality but also imposes substantial socioeconomic and healthcare burdens because of prolonged disability and rehabilitation requirements. Advances in preventive medicine and better control of vascular risk factors have considerably reduced stroke-related mortality over the last three decades. Nevertheless, stroke continues to be a major cause of neurological morbidity worldwide. [3,4]

Several established risk factors such as hypertension, diabetes mellitus, smoking, obesity, atrial fibrillation, and dyslipidaemia are known to contribute to the development of ischemic stroke. Among these, dyslipidaemia has gained considerable attention because it is a potentially correctable and preventable risk factor. Altered lipid metabolism plays a central role in the development of atherosclerosis, which subsequently leads to narrowing and occlusion of cerebral blood vessels. Elevated serum total cholesterol, low-density lipoprotein (LDL) cholesterol, triglycerides, and very low-density lipoprotein (VLDL) cholesterol, along with reduced high-density lipoprotein (HDL)

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cholesterol, are commonly associated with increased cerebrovascular risk. [5,6]

Numerous epidemiological and clinical studies conducted in different populations have demonstrated a significant association between abnormal lipid profiles and ischemic stroke. Reduction of serum cholesterol levels, particularly LDL cholesterol, through lifestyle modification and pharmacological interventions such as statin therapy has been shown to decrease the incidence of stroke and improve cardiovascular outcomes. Therefore, assessment of lipid abnormalities in stroke patients is important not only for understanding disease pathogenesis but also for planning strategies aimed at primary and secondary prevention. [7,8]

Carotid Intima-Media Thickness (CIMT) has emerged as a valuable non-invasive marker for detecting subclinical atherosclerosis. CIMT is defined as the distance between the lumen-intima interface and the media-adventitia interface of the carotid arterial wall as measured by B-mode ultrasonography. Increased CIMT reflects early atherosclerotic vascular changes and has been associated with higher risk of ischemic stroke and cardiovascular events. Measurement of CIMT, along with lipid profile assessment, may provide additional insight into vascular risk stratification in patients with acute cerebral ischemia. [9]

Hence, the present study aims to evaluate the association between altered lipid metabolism and acute cerebral ischemia and to assess the role of lipid abnormalities as potential risk factors in patients presenting with ischemic stroke.

Aim

To study the association between altered lipid metabolism and acute cerebral ischemia.

Objectives

1. To evaluate the lipid profile parameters in patients with acute cerebral ischemia.
2. To determine the prevalence of dyslipidaemia among patients presenting with ischemic stroke.

METHODOLOGY

This hospital-based observational study was conducted in the Department of Emergency Medicine at Sree Mookambika Institute of Medical Sciences, Kulasekharam, from June 2025 to March 2026. The main aim of the study was to determine whether hypocholesterolemia is a risk factor for primary intracerebral hemorrhage (ICH) and to compare serum cholesterol and triglyceride (TG) levels between ischemic and hemorrhagic stroke patients. Patients aged between 40 and 80 years of either sex presenting with clinical features suggestive of stroke and confirmed by computed tomography (CT) scan or magnetic resonance imaging (MRI) showing cerebral infarction or intracerebral hemorrhage were included in the study. Patients with underlying systemic illnesses such as liver disease, familial hypercholesterolemia, hypothyroidism, those receiving anti-lipid or sympathomimetic drugs, and patients with cerebral hemorrhage secondary to trauma, brain tumors, or coagulation disorders were excluded from the study. A detailed clinical history and thorough physical examination were performed in all patients. Blood samples were collected after an overnight fasting period of 9–12 hours for estimation of lipid profile parameters including total cholesterol, triglycerides, low-density lipoprotein (LDL), high-density lipoprotein (HDL), and very low-density lipoprotein (VLDL). The obtained lipid values were compared between ischemic and hemorrhagic stroke groups. Additionally, lipid profile values of apparently healthy individuals from the same community were used for comparison, and the subjects were matched for age and sex with the study population.

All collected data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) software version 25.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Independent sample t-test was used to compare mean lipid profile values between groups, and Chi-square test was applied for categorical variables. A p-value of less than 0.05 was considered statistically significant.

RESULT

Table No.1: Distribution of Cases Based On Lipid Profile

Variables	Low/High	No. Of Patients	Percentage
TC	<200mg/Dl	17	34
	>200 Mg/Dl	33	66
LDL	<130 Mg/Dl	14	28
	>130 Mg/Dl	36	72
HDL	<40 Mg/Dl	33	66
	>40 Mg/Dl	17	34
TG	<150 Mg/Dl	14	28
	>150 Mg/Dl	36	72

Above table shows the distribution of 50 patients according to fasting lipid profile. Majority of the patients 66% had high total cholesterol, 72% had high LDL, 66% had low HDL and 72% had high triglycerides.

Table No.2: Distribution of Gender with Fasting Lipid Profile.

	Low/High	Female N (%)	Male N (%)	P Value
TC	<200mg/Dl	5(10.0)	12(24.0)	0.757
	>200 Mg/Dl	12(24.0)	21(42.0)	
TG	<150 Mg/Dl	4(8.0)	10(20.0)	0.746
	>150 Mg/Dl	13(26.0)	23(46.0)	
HDL	<40 Mg/Dl	10(20.0)	23(46.0)	0.534
	>40 Mg/Dl	07(14.0)	10(20.0)	
LDL	<130 Mg/Dl	04(8.0)	10(20.0)	0.746
	>130 Mg/Dl	13(26.0)	23(46.0)	

The table above shows distribution of gender with fasting lipid profile. There was no significant correlation between gender and fasting lipid profile. Majority of male patients (42%) with high total cholestrol, (46%) with high triglycerides, (46%) with low HDL and (46%) with high LDL.Majority of
Female patients (24%) with high total cholestrol, (26%) with high triglycerides, (20%) with low HDL and (26%) with high LDL.

Table No.:3: Distribution of Gender with Cimt:

Sex	CIMT (<0.75) N(%)	CIMT (>0.75) N(%)
Male	10(20)	23 (46)
Female	04(08)	13(26)

P=0.746
Table shows distribution of gender with CIMT. There was no significant correlation between gender and CIMT. 46 % of male patients and 26% of female patients had high CIMT.

Table No.4: Distribution of Diabetes with Fasting Lipid Profile:

	Low/High	Diabetes		P Value
		No N(%)	Yes N (%)	
TC	<200mg/Dl	14(28.0)	3(6.0)	0.001*
	>200 Mg/Dl	1(2.0)	32(64.0)	
TG	<150 Mg/Dl	12(24.0)	2(4.0)	0.001*
	>150 Mg/Dl	3(6.0)	33(66.0)	
HDL	<40 Mg/Dl	11(22.0)	22(44.0)	0.533
	>40 Mg/Dl	4(8.0)	13(26.0)	
LDL	<130 Mg/Dl	12(24.0)	2(4.0)	0.001*
	>130 Mg/Dl	3(6.0)	33(66.0)	

The above table shows the distribution of diabetes with fasting lipid profile. There was a statistically significant correlation between diabetes and total cholesterol (p= 0.001), triglycerides (p= 0.001) and LDL (p= 0.001). Number of diabetic patients with high total cholesterol (64%), triglycerides (66%), low HDL (44%) and high LDL (66%).

Table No.: 5: Hypertension and Lipid Profile Distribution:

	Low/High	Hypertension		P Value
		No N(%)	Yes N (%)	

TC	<200mg/Dl	5(10.0)	12(24.0)	1.00
	>200 Mg/Dl	11(22.0)	22(44.0)	
TG	<150 Mg/Dl	4(8.0)	10(20.0)	1.00
	>150 Mg/Dl	12(24.0)	24(48.0)	
HDL	<40 Mg/Dl	10(20.0)	23(46.0)	0.757
	>40 Mg/Dl	6(12.0)	11(22.0)	
LDL	<130 Mg/Dl	04(08)	10(20)	1.00
	>130 Mg/Dl	12(24)	34(68)	

The table shows distribution of hypertension with lipid profile. There was no positive correlation between them. The number of hypertensive patients with high cholesterol (44%), high triglycerides (48%), low HDL (46%) and high LDL (68%) among the study population.

Table No.6: Correlation of Fasting Lipid Profile with Cimt:

	Low/High	**CIMT**		**P Value**
		(<0.75)	**(>0.75)**	
		N(%)	**N (%)**	
TC	<200mg/Dl	14(28.0)	3(6.0)	0.001*
	>200 Mg/Dl	0	33(66.0)	
TG	<150 Mg/Dl	13(26.0)	01(2.0)	0.001*
	>150 Mg/Dl	01(2.0)	35(70.0)	
HDL	<40 Mg/Dl	11(22.0)	22(44.0)	0.327
	>40 Mg/Dl	03(6.0)	14(28.0)	
LDL	<130 Mg/Dl	13(26.0)	01(2.0)	0.001*
	>130 Mg/Dl	01(2.0)	35(70.0)	

Table shows that there was a statistically significant positive correlation between the CIMT and total cholesterol (p= 0.001), triglycerides (p= 0.001) and LDL(p= 0.001). Among the study population, the number of patients with high total cholesterol(60%) , high triglycerides (70%) , low HDL (44%) and high LDL (70%).

DISCUSSION

The present study evaluated the association between altered lipid metabolism and acute cerebral ischemia among 50 patients admitted with stroke. Dyslipidaemia was found to be highly prevalent among the study population. Majority of the patients had elevated total cholesterol (66%), high LDL cholesterol (72%), elevated triglycerides (72%), and low HDL cholesterol levels (66%). These findings support the role of abnormal lipid metabolism as a major modifiable risk factor for cerebrovascular disease and are consistent with previous studies demonstrating the relationship between dyslipidaemia and ischemic stroke. [10,11]

In the present study, elevated LDL cholesterol and triglyceride levels were observed in the majority of stroke patients. LDL cholesterol plays a crucial role in atherosclerotic plaque formation, endothelial dysfunction, and vascular inflammation, thereby increasing the risk of cerebral ischemia. Elevated triglyceride levels are also associated with increased blood viscosity and accelerated atherosclerosis. Similar findings were reported by Amarenco et al., who demonstrated that elevated LDL and triglycerides significantly contribute to ischemic stroke risk. [12]

Low HDL cholesterol levels were identified in 66% of patients in the present study. HDL cholesterol has a protective role against atherosclerosis due to its anti-inflammatory and reverse cholesterol transport properties. Reduced HDL levels may therefore predispose individuals to cerebrovascular events. Previous studies have similarly reported lower HDL levels among patients with ischemic stroke compared to healthy controls. [13]

Gender-wise distribution of lipid abnormalities in the present study showed a predominance among male patients; however, the association between gender and lipid profile parameters was not statistically significant. Male patients had higher proportions of elevated total cholesterol, triglycerides, and LDL levels compared to females. Similar observations were made in earlier studies where dyslipidaemia was more common in males due to lifestyle factors such as smoking, alcohol intake, sedentary habits, and dietary patterns. Nevertheless, statistical significance was not demonstrated, indicating that lipid abnormalities may affect both sexes equally in stroke patients. [14]

The present study also demonstrated a statistically significant association between diabetes mellitus and abnormal lipid profile parameters including total cholesterol, triglycerides, and LDL cholesterol (p=0.001). Diabetic patients had markedly higher prevalence of elevated cholesterol and triglyceride levels. Diabetes mellitus is known to accelerate atherosclerosis through insulin resistance, endothelial dysfunction, and altered lipid metabolism. These findings are consistent with previous studies that identified diabetes-associated dyslipidaemia as an important contributor to ischemic stroke risk. [15]

Although a higher proportion of hypertensive patients exhibited elevated cholesterol, triglycerides, and LDL levels, no statistically significant association was found between hypertension and lipid profile in the present study. Hypertension remains an independent risk factor for stroke; however, its coexistence with dyslipidaemia may further increase vascular damage and atherosclerotic progression. Similar findings were reported in studies where hypertension and dyslipidaemia frequently coexisted without demonstrating direct statistical correlation. [16]

Carotid Intima-Media Thickness (CIMT), a marker of subclinical atherosclerosis, was elevated in a significant proportion of patients, especially among males. Increased CIMT has been strongly associated with vascular endothelial injury and future cerebrovascular events. The present findings support the usefulness of CIMT as a non-invasive predictor of atherosclerotic burden in stroke patients. [17]

Overall, the present study highlights the strong association between dyslipidaemia and acute cerebral ischemia. Early identification and management of lipid abnormalities through lifestyle modification and pharmacological therapy may help reduce stroke incidence and improve long-term outcomes.

CONCLUSION

The present study demonstrated a significant association between altered lipid metabolism and acute cerebral ischemia. Majority of the patients had abnormal lipid profile parameters, including elevated total cholesterol, triglycerides, LDL cholesterol, and reduced HDL cholesterol levels. These findings emphasize the important role of dyslipidaemia as a major modifiable risk factor for ischemic stroke. A significant association was observed between diabetes mellitus and abnormal lipid profile parameters, particularly elevated total cholesterol, triglycerides, and LDL cholesterol. Although hypertension and gender did not show statistically significant correlation with lipid abnormalities, a higher prevalence of dyslipidaemia was observed among hypertensive and male patients. Increased carotid intima-media thickness (CIMT) in a considerable proportion of patients further supports the role of atherosclerosis in the pathogenesis of acute cerebral ischemia. Early identification and effective management of dyslipidaemia through lifestyle modifications and lipid-lowering therapy may help in reducing the incidence, recurrence, morbidity, and mortality associated with stroke.

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